

Technical Review of the Westlands Water District Proposal Presented to the Department of Interior, Hoopa Valley Tribe, and Yurok Tribe on October 14, 2003 and November 20, 2003

Prepared by:

Hoopa Valley Tribal Fisheries Department P.O. Box 417 Hoopa, CA 95546

INTRODUCTION

On October 14, in Sacramento, California, representatives of the Westlands Water District and San Luis & Delta-Mendota Water Authority (Westlands), including Dr. Matt O'Connor and Dr. Don Chapman, met with representatives of the United States and the Hoopa Valley and Yurok Tribes. Westlands General Manager Thomas Birmingham and Drs. O'Connor and Chapman presented annual hydrographs developed for Westlands for each of five water year classes contained in the Trinity River Flow Evaluation Study Final Report (June 1999) (TRFES) and Trinity River Mainstem Fishery Restoration Record of Decision (December 19, 2000) (ROD). A second meeting was convened on November 20 in Arcata, California, at which Dr. O'Connor and Dr. Chapman were provided additional time to expand on technical aspects of the presentation and to address questions by federal and tribal scientists. The hydrographs incorporated a smaller volume of water and a different water year classification protocol from those in the TRFES and ROD. The memorandum, hydrographs, and water year classification protocol presented at the October 14 meeting constitute a proposal (hereafter "Proposal") by Westlands to settle pending litigation that challenges the fishery restoration program adopted by the Secretary of the Interior in the ROD. Westlands Water District v. United States, Civ F 00-7124 OWW DLB (E.D. Calif.), appeal pending Nos. 03-15194, 03-15289, 03-15291 (9th Cir.) The memorandum furnished at the meeting and a summary of the Proposal posted on the Westlands website (www.westlandswater.org) are attached hereto.

PROPOSAL

Drs. O'Connor and Chapman stated that they prepared the Proposal on the basis of a diversion regimen for the Trinity River Division that had been predetermined by Westlands' managers as an alternative to the flow releases identified in the TRFES/ROD.

Like the TRFES/ROD, the Proposal includes recommended annual volumes of instream flow releases based on water year type. However, Westlands representatives based the Proposal on the amount of Trinity River Division water that would remain available for release to the Trinity River after the amount and priority of Central Valley Project water sought by Westlands had been accommodated. To meet Westlands objectives, the Proposal modifies both the TRFES/ROD water year classification protocol and the annual hydrographs. Annual volumes based on water year type under the TRFES/ROD and the Proposal are set forth in Table 1.

ANALYSIS

The Proposal at page 1 states that "The quantities of water offered in the Settlement Proposal ... will provide essentially the same biological and channel modification outcomes as TRFES proposed flows." In fact, the Proposal does not provide for the full set of biological and geomorphic functions identified in the TRFES that are necessary to restore ecosystem health to the Trinity River. Nor does the Proposal account for its negative impacts on several key restoration objectives. In addition, the Proposal elevates the risk of failure in achieving legally mandated fishery restoration. Table 2 sets forth the biological and physical processes deemed by the TRFES to be vital to successful fishery restoration, and contrasts impacts of ROD flow allocations with those of the Proposal.

A. Changes In Water Year Frequency, Annual Water Volume, and Releases

Natural variability in water supply conditions and discharges are key to the restoration strategy employed in the TRFES and ROD. Across sequences of drought and flood years, the interplay of flows, sediments, and riparian vegetation is responsible for the character and extent of fish habitat, and consequently the resiliency and productivity of the Trinity River fishery. The Proposal substantially alters water supply conditions by: increasing the frequency of Critically Dry water years by 133%; reducing the frequency of Extremely Wet years by 25%; and decreasing the frequency of Wet years by 11% (Figure 1). As illustrated in Figure 2, these changes are substantial in many water years. While the weighted average annual reduction in water yield is 37,000 acre-ft, yearly reductions in flow volume can exceed 110,000 acre-ft, as occurred in 15 years over the 87 year period of record (Table 1, Figure 2). The frequency of consecutive Critically Dry years increases substantially (Figure 3). The Westlands proposal neglects to evaluate the ecological impacts of altering the ROD's water year classification protocol, with severe impacts to restoration that are discussed in Section C below.

Dr. O'Connor recognized that coarse sediment balance in the Trinity River mainstem is a critical feature of the restoration program, and recognized that because the Proposal reduced the frequency of Wet and Extremely Wet water years, sediment transport would also be reduced. Using the hydrographs in the Proposal distributed at the October 14, 2003 meeting and averaging TRFES sediment transport curves at Lewiston and Limekiln Gulch, our computations predict that the Proposal reduces coarse and fine sediment transport capacity by 14% and 13%, respectively, compared to the TRFES over the 1912-2002 period of record. After the October 14 meeting, in the only analysis conducted by Westlands consultants in support of the Proposal, Dr. O'Connor suggested modifying the Proposal to meet needed sediment transport rates with less water by increasing peak flow magnitudes while: (1) reducing duration of peak flows, and (2) reducing volumes of "snowmelt runoff" releases by steepening the receding limb of the hydrographs. Following the suggested modification to the Proposal provided by Dr. O'Connor, our computations predict that coarse and fine sediment transport capacity would be reduced by 4% and 7%, respectively compared to the TRFES.

Although the sediment transport capacity impacts of the Proposal are partially mitigated by Dr. O'Connor's suggested modification to the Proposal, the duration of the high flow release would be reduced and the snowmelt recession limb would be steepened compared to the TRFES. The receding limb of the TRFES hydrograph is based on a natural (pre-TRD) recession rate, and is designed to achieve successful riparian regeneration in wetter years, minimize salmonid stranding impacts, minimize amphibian egg mass desiccation, and satisfy needs of other native plants and animals that were not specifically identified in the TRFES. The Proposal, as well as Dr. O'Connor's suggested modifications, severely impairs the ability of the snowmelt hydrograph to satisfy other biological objectives that are critical to restoration.

More importantly, the Proposal and Dr. O'Connor's modification eliminates a source of water volume important for adaptive management program flexibility. This management flexibility is essential given that the TRFES and ROD only provide 47% of the natural average annual inflow to Trinity Lake. For example, tributaries below Lewiston yield varying volumes of sediment to the Trinity River each year; tributaries yield large volumes some years and smaller volumes in other years. The TRFES hydrographs have been developed to satisfy both the sediment transport needs and the biological goals for any given year. The Proposal and Dr. O'Connor's modification reduce adaptive management flexibility and increases risk of program failure (see Section C below), and there will be many years when geomorphic and/or biological goals will not be satisfied under the Proposal or modification.

While Dr. O'Connor provides a sediment transport capacity computation of the Proposal and modification, neither Dr. O'Connor or Dr. Chapman provides an analysis of the impact of reducing receding limb flows on river temperatures, smolt outmigration, stranding, riparian regeneration, or amphibian life cycles, which are integral features of the snowmelt hydrograph.

B. Assertion of Biological Harm From TRFES/ROD Flows

Westlands' consultants do not propose to alter the biological and channel modifications projected in the TRFES. However, Dr. Chapman concludes that the TRFES's recovery strategy, if fully implemented, would cause steelhead and coho populations to decline. He also concludes that river bar formation targeted in the TRFES, a natural process in healthy rivers, would deprive juvenile Chinook salmon of critical rearing habitat associated with woody riparian vegetation. Nonetheless, Dr. Chapman recommends reducing summer baseflows from 450 cfs to 400 cfs, and using this saved water (18,000 acre-ft) to increase flows between February 15 and April 1 such that riparian vegetation would be inundated during the fry and juvenile rearing period. Dr. Chapman ignores the TRFES 450 cfs summer baseflows needed to meet water temperature objectives that protect spring-run chinook salmon. The 450 cfs summer baseflow provides optimal water temperatures for oversummering adult spring-run Chinook salmon from Lewiston Dam downstream to Douglas City (approximately 20 miles). The temperature criteria and associated 450 cfs flow to achieve it were developed by the California Regional Water Quality Control Board, in close coordination with the USFWS, DFG, and Hoopa Valley Tribe, to protect holding/ spawning spring-run Chinook salmon. Because the TRD blocks access to historical colderwater habitats historically used by spring-run Chinook salmon, the river downstream of Lewiston Dam must now perform that role. Providing only 20 miles of suitable holding/ spawning habitat is a substantial compromise to historical conditions. Reducing these summer baseflows would further reduce the length of river channel providing suitable holding/spawning habitat for spring-run Chinook salmon, increasing adult pre-spawning mortality and correspondingly reducing egg production.

We agree with Dr. Chapman that submerging feathery vegetation (e.g., young willows) between February 15 and April 1 provides high quality fry and juvenile Chinook salmon rearing habitat. Aerial photographs below Lewiston prior to dam closure (e.g., Figure 4.23 in

the TRFE, p.77) show considerable woody vegetation established within the active mainstem channel. The goal of the TRFES, contrary to what Dr. Chapman appears to have interpreted from the TRFES, is not to eliminate woody riparian vegetation from the active mainstem channel. Rather, the goal is to remove many riparian berms containing mature and dying stands of alders and narrow leaf willow, and have the river replace them with active alluvial bars, a complex channel morphology, and younger age classes of riparian vegetation. Flows provided under the TRFES/ROD will provide the high quality habitat required by chinook fry, including the submerged vegetation referred to by Dr. Chapman.

Lastly, Dr. Chapman identified several potential concerns about components of the TRFES, such as water temperatures for improved growth rates and the potential impacts of thermal differences between the Trinity and Klamath rivers. The concerns raised by Dr. Chapman have been considered by groups of Federal, State, and Tribal scientists who prepared and peer-reviewed the TRFES. Because Dr. Chapman did not have the benefit of participating in that multi-year effort, he could not have been aware of everything TRFES scientists considered. We note that the TRFES scientists identified items for consideration under the adaptive management program.

C. Assigning More Risk To The Trinity River Fishery

Managing with risk is especially challenging in a watershed such as the Trinity River, which has an impassable dam, permanent loss of 109 miles of river habitat, and has experienced diversions at the dam location of up to 90 percent of its flow volume. The TRFES undertakes to manage that risk by correlating flow releases with naturally occurring hydrology, including Dry and Critically Dry annual flow releases. If a Critically Dry water year is occurring throughout the Trinity River Basin, the TRFES requires a Critically Dry annual flow release below Lewiston. Many advocated replacing Dry and Critically Dry annual flow releases with higher flow volumes to ameliorate adverse drier water year conditions. However, Federal and Tribal scientists recognized that Dry and Critically Dry water years play important roles in creating and maintaining a healthy river ecosystem. This approach is not without risk. There can be damaging ecological consequences to successive Critically Dry annual flow releases from the TRD. For example, persistent low flows will result in riparian re-encroachment and re-fossilization of active gravel bars, which would destroy the complex aquatic habitat needed to achieve mandated fishery restoration goals.

Our research has shown that maximum TRFES flow magnitudes (during Extremely Wet years) are most effective at scouring away a plant that is two years old or younger; the root structure and size of older seedlings greatly reduce the effectiveness of scouring flows. Figure 3 illustrates that based on analysis of the 1912-2002 period of record, the Proposal would result in three instances where 3 consecutive Critically Dry water years would occur. Under these circumstances, when flows sufficient to scour seedlings do not occur at least every third year, riparian encroachment will occur and habitat will rapidly revert to poor conditions. Hence, the Proposal would allow damaging riparian encroachment to occur three times out of the 87 years of record, whereas the TRFES would prevent this.

The scientific literature on adaptive management includes numerous examples of how the inability to predict precisely the results of restoration efforts has undercut the use of best available estimates for flow needs. That literature demonstrates how the acceptance of lower flows in the face of relative uncertainty greatly increases the risk of failure. Consider the example of designing a structure such as a public bridge. If there is uncertainty in the stresses on the bridge, the design would not provide for less steel. Instead, the design must include an amount and quality of steel to accommodate the uncertainties and reduce or eliminate the risk of social, financial, and economic losses that would accompany failure of the bridge.

Trinity River Chinook populations exist at the environmentally harsh fringe of their geographic range. Salmon populations rely on the few but favorable wet water years to offset increasingly common dry water years farther south along the Pacific coast. We analyzed how the changes in water year classes proposed by Westlands impacted the frequency of water years and found that Critically Dry water years increased 133% over the TRFES when using the 1912-2002 period of record (Figure 2). The TRFES already assigns risk to the fishery by having Critically Dry years in 12 out of 100 years; the Proposal greatly increases this risk to the fishery by increasing the number of Critically Dry years to 26 out of 100 years. This increase in consecutive Critically Dry years, including the corresponding 25% reduction of Extremely Wet years, assures that riparian encroachment would recur and the channel upstream of the North Fork Trinity River would eventually revert to the undesirable habitat conditions that resulted from construction and operation of the TRD. As concluded in the TRFES (and supported by peer reviews), the fishery cannot be recovered without maintaining alluvial channel morphology and preventing riparian encroachment. Figure 3 clearly illustrates that the Proposal cannot prevent riparian encroachment, and thus cannot achieve fishery restoration goals.

In the case of the TRFES/ROD, every effort was made to identify accurately the amounts of water needed for fishery restoration. By themselves, the legal mandates for restoration and the priority for in-basin use of Trinity River water might have been used to justify the allocation of more than half of the Trinity River's flow at Lewiston to the restoration program. However, the TRFES, adhering to the best available scientific information, carefully identified the need for an annual average of 47 percent of the Trinity River's flow at Lewiston. The Proposal does not provide any scientific justification for further reducing the 47 percent average annual allocation to fishery restoration provided for in the TRFES/ROD.

CONCLUSION

The Proposal reduces flow volumes in most water years, reduces the frequency of wetter water years, and increases the frequency of the driest water years. The Proposal includes no new scientific information to support the assertion that the Proposal will provide essentially the same biological outcomes as the TRFES. In fact, the consequences of the proposed decreases in water supply and modifications in water year classification will result in the failure of the restoration program, particularly because the Proposal:

- 1. Fails to evaluate the ecological impacts of altering the ROD's water year classification protocol, as well as many of the ecological impacts of modifying the release hydrographs.
- 2. Modifies the water year classification by decreasing wetter years and increasing drier years, which will result in riparian encroachment and failure to achieve aquatic habitat restoration.
- 3. Addresses scientific uncertainty by increasing the risk of failure to the fishery.

Federal, State, and Tribal scientists who prepared the TRFES were required to justify the amounts of water identified as needed for the restoration program. No "surplus" water was included in the TRFES recommendations that can now be reduced to accommodate the Proposal.

The Trinity River provision of the Central Valley Project Improvement Act (Public Law 102-575 §3406(b)(23)) requires the establishment of permanent Trinity River Division releases to meet Trinity River instream fishery flow requirements "based on the best available scientific data." The Proposal does not improve upon the science contained in the TRFES and ROD, and as shown above, actually increases the risk of failure in achieving restoration objectives. Accordingly, Tribal scientists conclude that the TRFES and ROD remain the best available scientific information with which to accomplish restoration mandates.

Table 1. Summary of TRFES annual flow volumes and comparison to Westlands' proposed flow volumes and water year frequencies (from Westlands consultants October 14 handout).

Water year type	TRFES flow volume	TRFES water year frequency	Westlands Proposal flow volume	Westlands Proposal water year frequency ¹
Extremely Wet	815,000 ac-ft	12%	815,200 acre-ft, but not more often than once every three years; 701,000 acre-ft if second Extremely Wet year.	10%
Wet	701,000 ac-ft	28%	701,000 ac-ft, but reduced to 650,000 ac-ft if follows an Extremely Wet year	26% (includes 2 nd Extremely Wet years)
Normal	649,900 ac-ft	20%	575,000 ac-ft	25% (includes Wet years following Extremely Wet years)
Dry	452,600 ac-ft	28%	400,000 ac-ft	14 % (50% of Dry years reclassified as Critically Dry years)
Critically Dry	368,600 ac-ft	12%	340,000 ac-ft	24% (50% of Dry years reclassified as Critically Dry years)
Weighted average	594,500 ac-ft		557,500 ac-ft ¹	
Difference:			37,000 ac-ft	

¹ based on analysis of historical record from WY 1912-2002 (Westlands consultants only considered 1912-1961 data rather than all of the available data). Westlands has since published on its website a version of its proposal that reclassifies a second successive Wet Year as Normal; however, their water year computations consistently follow the rule stated in the October 14, 2003 handout, so the website version is assumed to be erroneous.

Table 2. Biological and geomorphological goals in the TRFES, and comparison of Westlands Proposal in achieving these goals.

	TRFES	Westlands	
	Restoration Goal	proposal performance ¹	Notes
OP	OPTIMAL water temperatures at Weitchpec for smolt outmigration ²		
	Extremely Wet water years	PASS	Identical to the TRFES
	Wet water years	IMPAIRED	Increased water temperatures for steelhead outmigrants prior to spring snowmelt peak, increased water temperatures for fall-run Chinook in early July.
	Normal water years	IMPAIRED OR FAIL	Increased water temperatures for fall-run Chinook during most of June and early July.
MA.	MARGINAL water temperatures at Weitchpec for smolt outmigration ²		
	Dry water years	IMPAIRED	Increased water temperatures for fall-run Chinook during portion of June.
	Dry water year-Reduced Peak option	PASS	This option on Dry year would reduce peak flow magnitude, but preserve the snowmelt hydrograph such that it is virtually identical to TRFES.
	Critically Dry water years	IMPAIRED	Increased water temperatures for fall-run Chinook during the latter portion of June.
OP Chi.	OPTIMAL water temperatures at Douglas City for spring-run Chinook summer holding²		
	All water years	IMPAIRED	Baseflow release reduced from 450 cfs to 400 cfs, which will reduce the length of Trinity River with suitable spring-run Chinook oversummering temperatures.
Bea floo	Bed mobility and scour on exposed gravel bars, channel migration, floodplain formation		
	All water years	IMPAIRED	Flow magnitude is identical to TRFES, but the frequency of Extremely Wet and Wet years is significantly reduced (Figure 1). Therefore, the frequency with which fluvial process objectives are achieved will be significantly reduced.

able 2. Continued

	TRFES Restoration Goal	Westlands proposal performance	Notes
Bala	Balanced coarse sediment budget, and deficit in fine sediment budget		
	Extremely Wet and Wet water years	IMPAIRED	Flow magnitude and duration are identical to TRFES, but the frequency of Extremely Wet and Wet years is significantly reduced (Figure 1). Sediment accumulation at the mouth of Trinity River tributaries will increase in those Extremely Wet and Wet years that the Proposal would reclassify as Wet or Normal. As a result, the Proposal's correspondingly lower releases from the TRD in those years will be inadequate to transport accumulated tributary sediments.
	Normal and Dry water years	IMPAIRED	Flow magnitude is identical to TRFES, but duration of flow magnitude is reduced and the recession limb is steepened, reducing coarse and fine sediment transport capacity.
	Overall	IMPAIRED	The Proposal reduces overall coarse sediment and fine sediment transport by approximately 13%³, almost all due to reducing the frequency of Extremely Wet and Wet water years. Increasing the peak flow magnitude and reducing the duration of the peak flow of the Proposal as suggested by Dr. O'Connor, can reduce the disparity in sediment transport to 4% for coarse sediment and 7% for fine sediment. However, the reduced high flow release volume for reclassified water years mandates a smaller magnitude and/or shorter duration flow than the TRFES, which will be insufficient to transport coarse sediment supplied by tributaries during certain Extremely Wet, Wet, and Normal water years where the sediment supply is larger than the available flow release volume can transport (due to the water year class downgrading).

Table 2. Continued.

	TRFES	Westlands	
	Restoration	proposal	
	Goal	performance ¹	Notes
Suc	Successful riparian regeneration on floodplains		
	Extremely Wet water years	PASS OR IMPAIRED	The recession limb on Extremely Wet water years is the same as the TRFES. However, based on the 1912-2002 period of record, the Proposal would reduce the frequency of Extremely Wet water years by 25% (Figure 1), such that the frequency of riparian regeneration on floodplains may also be reduced by 25% (if the Wet water year recession rate is too steep to allow riparian regeneration).
	Wet water years	PASS OR IMPAIRED	The Proposal recession limb on Wet water years is slightly steeper than the TRFES, possibly decreasing successful riparian seedling survival on floodplains due to desiccation mortality. In addition, the Proposal reduces frequency of Wet water years by 11% (Figure 1), such that the frequency of riparian regeneration on floodplains may also be reduced accordingly.
Pre	Prevent riparian encroachment on exposed gravel bars		
	Cause riparian scour mortality in individual Extremely Wet and Wet years	PASS	The magnitude of the peak flows during Extremely Wet and Wet water years is the same as the TRFES.
	Prevent riparian encroachment	FAIL	The Proposal reduces frequency of Extremely Wet and Wet water years, and combined with the increased frequency in Critically Dry years, the Proposal will create successive year seedling initiation windows that will guarantee riparian encroachment.

Table 2. Continued.

	TRFES Restoration	Westlands proposal	
	Goal	performance ¹	Notes
Suc	Successful reproduction of Yellow-legged frogs		
	Extremely Wet and Wet water years	PASS OR IMPAIRED	The Proposal recession limb for Extremely Wet years is identical to the TRFES, although the Proposal recession limb for Wet years has a slightly earlier recession in late June. The frequency of Extremely Wet and Wet water years decrease with the Proposal, and because these are the water years with recession limbs conducive to successful production of Yellowlegged frogs, their productivity will also likely decrease.
	Normal and Dry water years	IMPAIRED	Steeper recession limb will increase egg mass desiccation and production failure; increased frequency of Normal years will reduce overall production.

¹ Qualitative assessment using the following criteria:

PASS – achieves intended TRFES objectives.

IMPAIRED – can cause periodic failure to achieve intended TRFES objectives, or does not fully satisfy TRFES objectives. FAIL – cumulatively causes failure to achieve intended TRFES objectives.

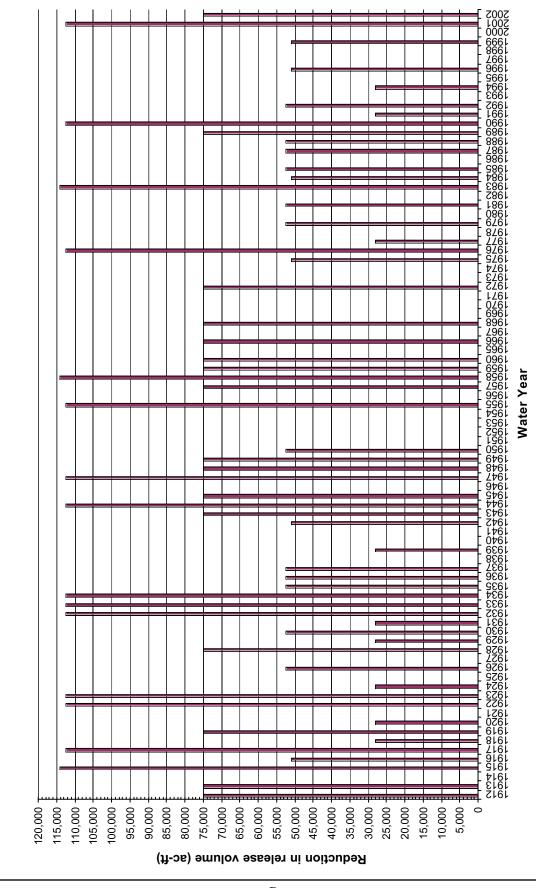
² Qualitative assessment, water temperature model has not been applied to the Westlands Proposal.

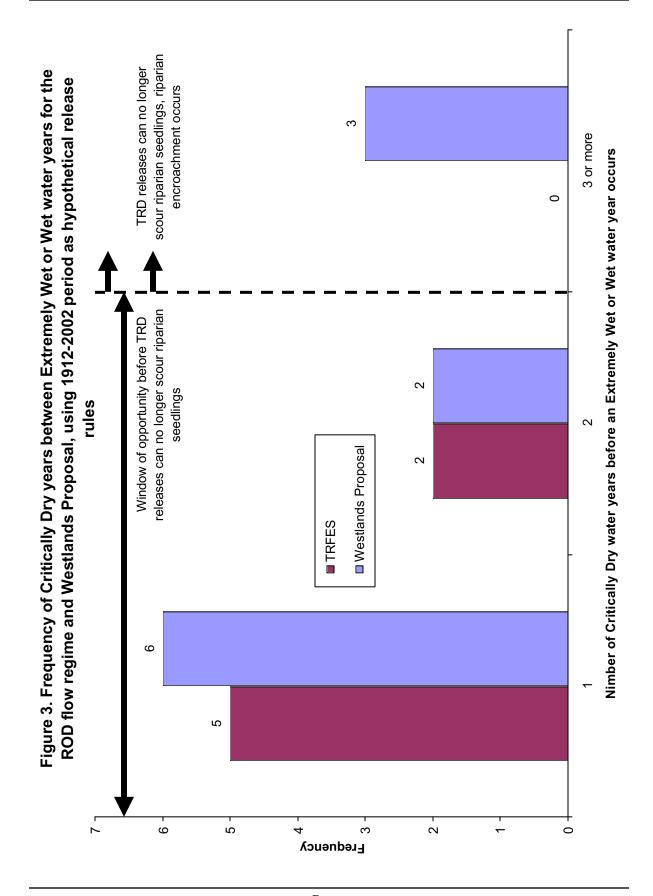
³ Using average prediction of Lewiston and Limekiln Gulch fine and coarse sediment transport curves as presented in TRFES.

Water years that cause riparian encroachment 33% increase Proposal (Wet year followed by Ext Wet year is considered to be a Normal year for this chart, Critically Dry 7 Figure 1. Comparison of frequency of water year types between TRFES and Westlands although the volume of the following Wet year is higher than the Normal year) 50% reduction 12 5 38% increase Water Year Water years that 22 encroachment Normal discourage riparian 16 11% reduction 23 <u>prevent</u> riparian encroachment 26 Water years most important to Wet Westlands Proposal **Extremely Wet** 25% reduction TRFES 12 Ö 25 2 30 20 15 9 Number of years

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Figure 2. Reduction in water volume by year comparing the TRFES and Westlands Proposal release volumes





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WESTLANDS SETTLEMENT PROPOSAL DISTRIBUTED TO THE BUREAU OF RECLAMATION, FISH AND WILDLIFE SERVICE, HOOPA VALLEY TRIBE, AND YUROK TRIBE ON OCTOBER 14, 2003



DANIEL J. O'HANLON ATTORNEY AT LAW

October 13, 2003

BY HAND DELIVERY

Kirk C. Rodgers Regional Director U.S. Bureau of Reclamation Mid-Pacific Region 2800 Cottage Way, P-100 Sacramento, CA 95821

> Re: Settlement Negotiations Relating to Trinity River Litigation

Dear Mr. Rodgers:

Please find enclosed a copy of a memorandum, including attachments, relating to the proposal made by the San Luis & Delta-Mendota Water Authority and Westlands Water District for settlement of the Trinity River litigation. The memo reflects the conclusions of a geomorphologist, Dr. O'Connor, and a fisheries biologist, Dr. Chapman, concerning the settlement proposal. Both Dr. O'Connor and Dr. Chapman will attend the meeting tomorrow afternoon to further discuss their conclusions.

We have included six copies of the memorandum, with attachments, so that you may distribute them to others within the Bureau and the Fish and Wildlife Service prior to tomorrow's meeting. We will send electronic versions of these documents to you this afternoon to aid your circulation of the documents.

Very truly yours,

KRONICK, MOSKOVITZ, TIEDEMANN & GIRARD

A Professional Corporation

Daniel J. O'Hanlon

DJO/dg Enclosures

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October 13, 2003

TO:

Daniel O'Hanlon, Esq.

Kronick, Moskovitz, Tiedemann & Girard

400 Capitol Mall, 27th Floor Sacramento, CA 95814-4416

FROM:

Matt O'Connor, PhD, RG #6847

President, O'Connor Environmental, Inc.

Don Chapman, PhD Bioanalysts, Inc.

RE: Evaluation of Geomorphic and Biological Effects of Proposed Settlement Flows
Compared to Record of Decision Flows

Summary and Conclusion

At your request, we have reviewed and evaluated the proposed restoration plan for the Trinity River as described in the "Trinity River Flow Evaluation, Final Report" (TRFE), dated June 1999, and the "Record of Decision" (ROD) dated December 2000. We have also reviewed a set of changes to the ROD flow regime proposed by the San Luis & Delta-Mendota Water Authority and Westlands Water District (the "Settlement Proposal"). These flows have been proposed in connection with a proposed settlement of the Trinity River litigation. You have asked us to provide our analysis of whether the Settlement Proposal would produce significantly different geomorphic and biological outcomes than the flows proposed in the TRFE and adopted in the ROD.

The quantities of water offered in the Settlement Proposal can be shaped substantially and delivered at times desired by fishery managers. We believe those quantities, if appropriately allocated and managed to meet agency and tribal objectives, will provide essentially the same biological and channel modification outcomes as TRFE Proposed Flows.

O'Connor Environmental, Inc. has developed a set of hydrographs for wet, normal, dry, and critically dry water years using the annual release volumes set forth in the Settlement Proposal. These hydrographs are attached under Tab B. These hydrographs illustrate how the key objectives of the ROD flow for geomorphic and other effects could be met within the lower annual flows of the Settlement Proposal. These hydrographs are but one example of how the annual release volumes in the Settlement Proposal could be allocated; managers could choose a different allocation as well.

The Settlement Proposal assumes the validity of the technical rationale supporting significant increases in annual bypass flows and the benefits for ecosystem restoration of a variable peak flow regime as described in the TRFE. Given that assumption, the question addressed in this memorandum is whether the volumes in the Settlement Proposal can be used to produce essentially the same projected outcomes as the higher volumes adopted in the ROD.

This memorandum first describes and discusses the hydrographs that illustrate how the flows in the Settlement Proposal can be used to meet the TRFE objectives. Second, this memorandum addresses uncertainties regarding the projected geomorphic outcomes of the ROD flows. Third, we address the likely effect of flows in the Settlement Proposal on projected biological outcomes.

1. Examples of Alternative Hydrographs Based on Proposed Settlement Annual Flow Releases

Attached under Tab A is a chart that compares the total annual releases for various year types under the ROD and under the Settlement Proposal. Attached under Tab B are annual hydrographs based on annual releases to the Trinity River in accordance with the Settlement Proposal. Attached under Tab C are spreadsheets that contain the release rates on which the hydrographs are based. In the spreadsheets, the daily flows for which an example adjustment was provided are enclosed in squares to highlight where they occur.

The hydrograph examples avoid reductions in proposed peak flows in order to meet the geomorphic effects sought from such peak flows. By preserving the peak flows, most of the restoration plan objectives pertaining to sediment transport and suppression of establishment of riparian vegetation at undesirable locations are likely to be accomplished. Total annual releases are reduced through a more rapid recession limb and a slightly reduced late summer and autumn baseflow than proposed in the TRFE. Adjustments to the recession limb would be expected to impact to some degree proposed beneficial effects of flows on water temperature and suppression of riparian vegetation.

Five alternative hydrographs are included in Tab B. Each hydrograph includes on the plot the 20-day moving average of pre-1960 mean daily discharge for the given water year class, as well as a confidence envelope of plus and minus one standard error of the mean. These pre-1960 flow data are included to help assess the proposed flow regime, particularly the recession limb of the hydrograph, with reference to the overall goals of restoring the ecosystem through mimicking pre-project flow conditions. We believe these example hydrographs would likely attain similar restoration effects compared with those proposed in the TRFE and ROD.

The Settlement Proposal specifies only annual volumes; managers would be free to allocate the volume and timing of releases as is most beneficial. The hydrographs in Tab B are examples only. As described in the next section, significant uncertainty exists with respect to sediment transport criteria that were used to develop TRFE proposed peak flow magnitude and duration. Although the example hydrographs do not significantly modify peak flow magnitude or duration, it may be desirable to consider the potential merit of small reductions in the peak flows in order that some of that water might be redistributed in the recession limb to satisfy temperature and/or riparian suppression criteria. One such example is provided in the Dry Year-Reduced Peak hydrograph. The TRFE analysis indicates that the long-term sediment transport accomplished by a 4,500 cfs flow is marginal, and this peak release is targeted on mobilizing fine sediment from spawning areas. The TRFE Dry Year hydrograph

* 1

recession limb appears to accept sub-optimal stream temperatures. The Dry Year-Reduced Peak example instead reduces the peak flow to the pre-project mean peak discharge of about 3,000 cfs, and then matches the TRFE recession limb beginning June 1.

2. The Uncertainties Underlying the Sediment Transport Studies Preclude Firm Predictions of the Precise Effect of Any Flow Regime

Some may question the validity of any variation from the ROD prescribed release volumes. The ROD flows are the culmination of many years of study; the implication is that exactly these flows are essential for restoration. We do not believe that insistence on the precise flows in the ROD can be scientifically justified using the available data.

We acknowledge that the TRFE represents the result of a substantial amount of work. We take no issue with much of the technical work underlying the TRFE. Despite the quality of scientific investigations conducted to support the restoration plan, in particular the work focused on identifying sediment transport thresholds, O'Connor Environmental believes there remains significant uncertainty regarding the quantitative aspects of the sediment transport studies (Section 5.4 of the TRFE).

Significant uncertainty exists in at least three specific areas: extrapolation of sediment transport rates over a range of flows, spatial extrapolation of sediment transport rates, and sediment supply rates from tributary streams. Each of these is discussed in more detail below. We think that these uncertainties preclude anyone from confidently predicting differing geomorphic outcomes as a result of the differences in annual release contained in the ROD and in the Settlement Proposal, respectively.

Extrapolation of Sediment Transport Rates Over a Range of Flows

Sediment transport rates for bedload were measured at two locations (Lewiston gage and Limekiln gage) for discharges ranging from about 4,000 cfs to 6,000 cfs at Lewiston and from about 2,500 cfs to 6,800 cfs at Limekiln. Curves were fit to these data as shown in Figures 5.36 and 5.37 in the TRFE, and extrapolated beyond the range of measurements to 14,000 cfs. The vast majority of anticipated bedload sediment transport under the proposed restoration plan occurs at flow levels of 8,500 cfs or greater (Table 5.7 in the TRFE). Confidence limits for the estimated transport rates were not presented in the TRFE, but they would be broad given the low number of data points. This unquantified uncertainty is significant with respect to the overall restoration plan insofar as the magnitude and duration of peak flows in the annual hydrograph are based largely on the bedload transport rate estimates.

Spatial Extrapolation of Sediment Transport Rates

As noted above, bedload sediment transport rate measurements occurred at two sites. These two sites were used to represent sediment transport rates in the upper reach of Trinity River extending from the North Fork Trinity River confluence to Lewiston, a distance of about 40 river miles. The TRFE notes in Section 5.4.3.4 that there are known areas of discontinuity of

bedload transport both in pools and in backwater areas upstream of major tributary junctions. The behavior of bedload sediment for proposed peak discharges greater than 6,800 cfs in these areas is unknown. Relationships between stream discharge and sediment transport relationships are sensitive to differences in channel slope and channel morphology (i.e. flow resistance). The proposed restoration flows may have unanticipated local effects on channel and habitat conditions, particularly with respect to areas of sediment deposition. This uncertainty is significant with respect to overall restoration plan because it could cause unanticipated channel changes affecting instream and riparian habitats, including areas where intensive channel restoration efforts are planned.

Sediment Supply Rates From Tributary Streams

Estimates of sediment inputs from four tributary streams were developed as described in Section 5.4.3.3. Estimates were developed for these four streams for Water Year 1997. These estimates were then extrapolated over different water year classes (wet, normal, etc.) by correlation with long-term sediment transport records for Grass Valley Creek. As noted in the TRFE, sediment inputs from tributaries can be expected to vary considerably. The statistical relationship between Grass Valley Creek and the other three tributaries based on a single year of correlation is not described in the TRFE; such a relationship has significant uncertainty. Consequently, the estimated sediment input rates for each tributary in each year class (Table 5.6 in the TRFE) have broad but undefined confidence bands around the estimated mean values. This uncertainty is significant with respect to the overall restoration plan because the duration of proposed peak flows are based on estimated sediment input rates.

Cumulative Uncertainty

The duration of proposed magnitude and duration of peak flows in the ROD are in large part based on bedload sediment input and transport criteria designed to provide transport rates greater than input rates. Two sets of relationships described above, each with significant uncertainty, define these criteria. Hence, the quantitative basis for the proposed restoration plan peak flow hydrographs is also subject to significant uncertainty.

In sum, we do not believe that insistence on the precise flows in the ROD can be justified by the available data regarding the anticipated geomorphic effects of the ROD flows. Furthermore, the data would not support a conclusion that the expected geomorphic effects of the ROD flows would be significantly different from the expected geomorphic effects of the Settlement Proposal.

3. The Proposed Settlement Flows Can Be Managed to Provide Essentially the Same Biological Outcomes As the ROD Flow

Dr. Don Chapman has reviewed the Settlement Proposal, and compared the example hydrographs to those in the ROD, to assess the potential for differences in likely biological outcomes from the two flow regimes. The two primary departures from the TRFE flow regime are: (1) a more rapid hydrograph recession and consequent reduction of "bench"

flows following "peak" flows; and (2) a reduction in the summer base flow. Dr. Chapman has concluded that the alternative flow volumes will produce essentially the same biological outcomes.

The first adjustment from the ROD flow regime that is reflected in the example hydrographs is an earlier recession and consequent reduction in the "bench" flows that follow after peak releases. "Bench" flows of 2,000 cfs for approximately one month prior to July 9 in Extremely Wet, Wet, and Normal water years are justified on p. 237 of the TRFE as needed "... to facilitate chinook smolt outmigration through July 9." The report justifies a similar bench of 1,500 cfs in Critically Dry years by noting that it "... will improve water temperatures for salmonids." A stable flow of these magnitudes may not be necessary or desirable for the time period and species/life stage in question. Unregulated streams used by fall chinook have a declining hydrograph limb during the outmigration of subyearlings. The species appears to have adapted to this pattern. The TRFE recognizes this on p. 220, noting that "Releases that mimic the snowmelt hydrograph in the spring and early summer improve conditions for smolt survival." We suggest that June flows might better be ramped down than held at bench levels.

We can envision a scenario in which bench flows of the magnitudes noted in the preceding paragraph may provide more total miles of river that lie within a desired literature-based temperature range, but a downside risk attends this flow manipulation. That is, water temperatures in the river reach most influenced by Lewiston Dam releases will be low relative to historic pre-dam conditions in May, June, and early July (Figure 4.31, p. 88, TRFE), retarding growth of subyearlings. We note that water temperatures at Lewiston before dam completion rose to over 62 F. by early June.

Miles of river available within a given temperature range should be considered relative to the known distribution and timing of spawning, incubation, and rearing by, particularly, fall chinook. Warmer water promotes earlier spawning, accrual of more temperature units by embryos and alevins by given dates, and earlier emergence. An evaluation of temperature units accrued after onset, peak, and end of spawning, and anticipated emergence dates would be useful. Such an evaluation, coupled with spawner distribution, might permit a better evaluation of effects of bench flows on juveniles in various lineal segments of the Trinity River. Cumulative catches of subyearlings at Willow Creek trap cannot provide information specific to this matter.

Growth response of subyearling chinook depends not only upon water temperature, but also on food availability. Juveniles with abundant macroinvertebrate (both aquatic and terrestrial) drift available to them will grow very rapidly at water temperatures considered marginally high (see Figure 5.56, p. 202, TRFE). We found no information or discussion in the TRFE on food supply, macroinvertebrate production, or drift.

The second adjustment from the ROD flow regime is reflected in the example hydrographs is a reduction in the summer base flows. It is difficult to predict what habitats will be available in the Trinity segments nearest to Lewiston under the different summer base flows. Those segments will be most modified by high stream power (6,000 cfs in normal years and about

8,000 in wet years). The shape of stream cross-sections could change considerably as a result of those flows.

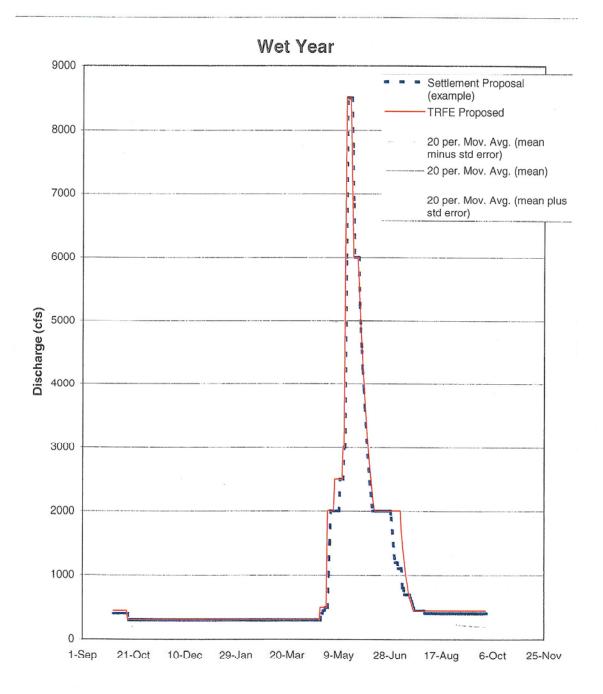
Further removed from Lewiston, there should be less change in stream cross-sections as a result of high flows, because of the attenuation of distance and influence of tributaries. It appears that WUA (see Figures 5.20 and 5.21 in the TRFEFR) in stream cross-sections in segments II and III (middle and lower, respectively) declines for fry and juveniles as flow increases in the area of 400+ cfs in those segments. That is, 400 cfs is better than 450 cfs for fry and juveniles. Thus, in those segments the Settlement Proposal summer base flows at 400 cfs should not disadvantage juveniles.

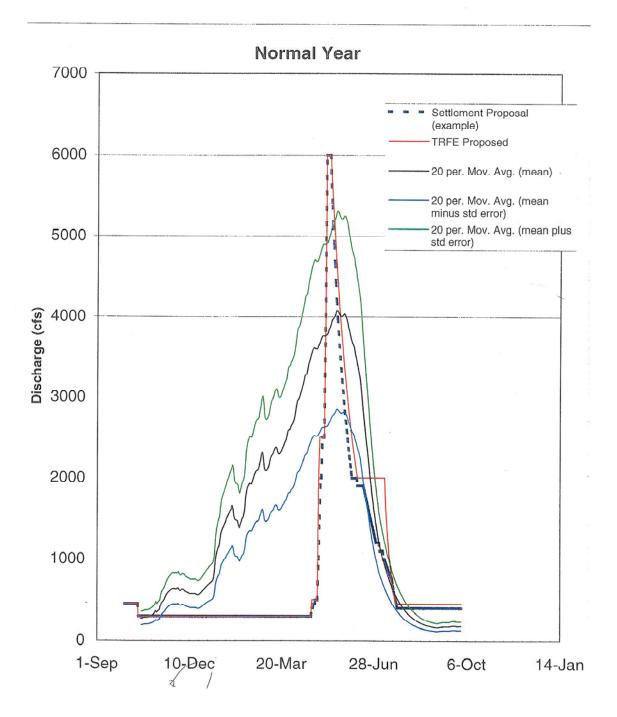
In sum, Dr. Chapman believes that the reduced annual qualities of releases in the Settlement Proposal will still provide essentially the same biological outcome as the flow volumes proposed in the TRFE and the ROD.

752930.1

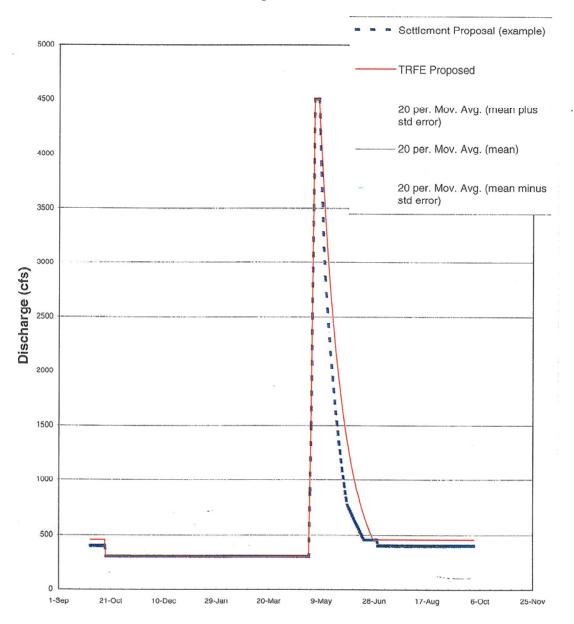
COMPARISON OF ROD AND SETTLEMENT PROPOSAL ANNUAL FLOW VOLUMES

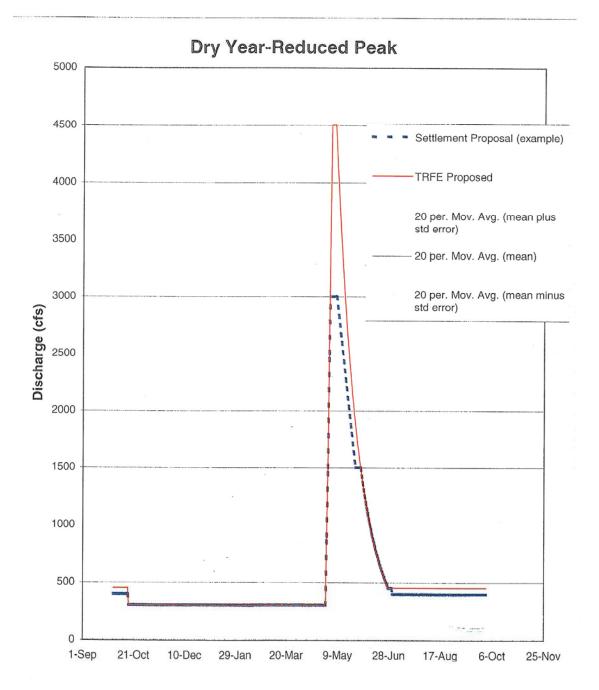
Year Type	Trinity River ROD	Settlement Proposal
Ex. Wet	815.2	815.2, but not more often than once every three years; 701 if follows an Ex. Wet Year
Wet	701	701, but 650 if follows an Ex. Wet Year
Normal	649.9	575
Dry	452.6	400, but redefine classification so 50% of Dry Years become Crit. Dry
Crit. Dry	368.6	340



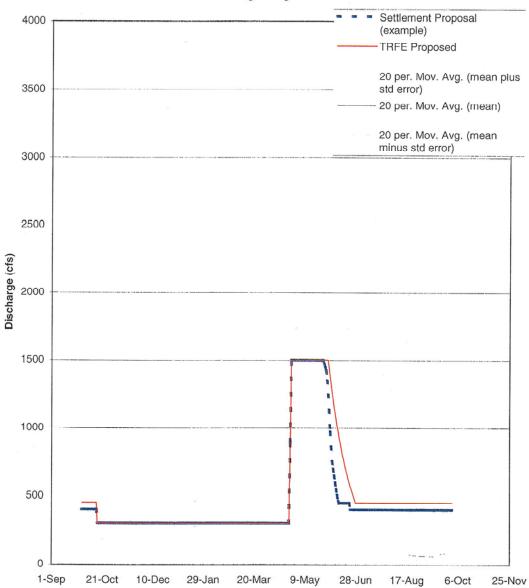


Dry Year









WESTLANDS SETTLEMENT PROPOSAL AS POSTED ON WESTLANDS WATER DISTRICT WEBSITE (WWW.WESTLANDSWATER.ORG)

Westlands Water District

Proposed Trinity River Settlement

Westlands Water District recently presented a proposed settlement to the Department of the Interior, representatives of the Hoopa Valley Tribe, and Trinity County officials. Westlands drafted the proposal after developments in California changed the long-term water supply outlook for south-of-Delta Central Valley Project contractors, including the farmers in Westlands. Those developments included the recently approved Quantification Settlement Agreement involving Colorado River water and a historic agreement to share assets and better coordinate the daily operations of California's State Water Project and the Central Valley Project.

Last year, a U.S. District Court overturned the Trinity River Record of Decision issued in 2000 because it failed to adequately address water supply impacts to the Central Valley Project and environmental impacts to endangered fish species in the San Francisco Bay / Delta estuary, and failed to consider a reasonable range of alternatives for accomplishing restoration. Since that ruling, Westlands has attempted to resolve the ongoing litigation through a long-term settlement proposal.

Westlands' proposal is designed to restore the Trinity River fishery in a manner that does not severely impact the water supplies of farms, cities and endangered fish species that rely upon the Central Valley Project. Although Westlands continues to have concerns about the approach adopted in the Record of Decision, in an effort to reach a compromise the proposal puts aside disputes over the science and closely mirrors restoration strategies contained in the 2000 Record of Decision. For example, under the Westlands proposal, peak spring and early summer flows are identical to those contained in the Record of Decision. Base flows in the summer and fall are only slightly less than those contained in the Record of Decision, and are in fact significantly greater than historic levels under both the Record of Decision and the settlement proposal. Over the long term, the Westlands proposal would deliver on average 92 percent of the water called for in the Record of Decision.

Key provisions of the Westlands proposal are as follows:

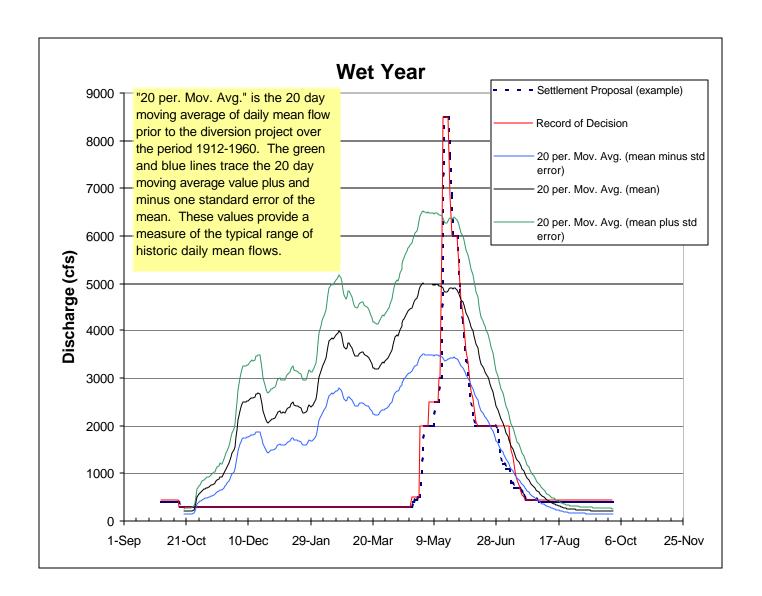
Year Type	Record of Decision (ac-ft)	Westlands Proposed Settlement (ac-ft)
Extremely Wet ¹	815,200	815,200
Wet ²	701,000	701,000
Normal	647,000	575,000
Dry ³	453,000	400,000
Critically Dry	368,000	340,000

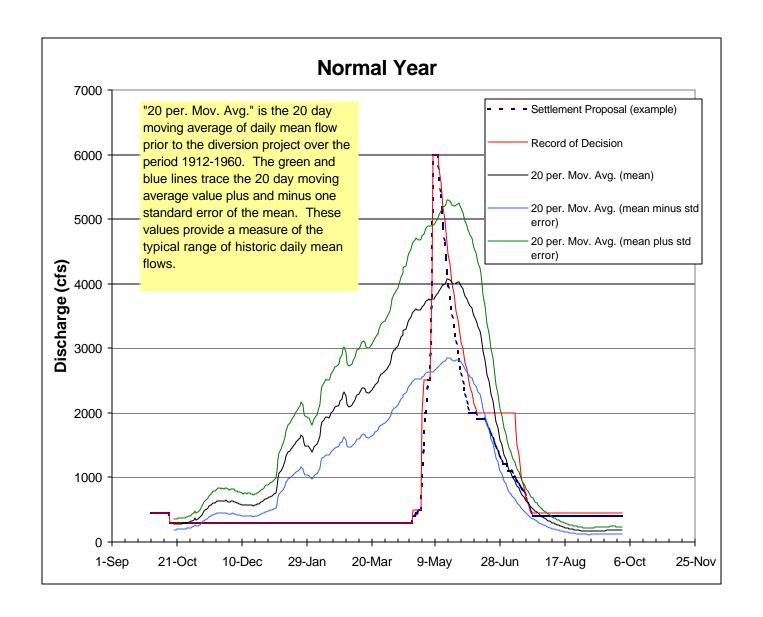
- 1. In two or three consecutive extremely wet years, flows revert to wet year flows in ROD (701,000 ac-ft) in second and third years.
- 2. In two consecutive wet years, flows revert to normal year flows in ROD (647,000 ac-ft) in second year.
- 3. One half of the dry years (the driest half) will be reclassified critically dry year types.

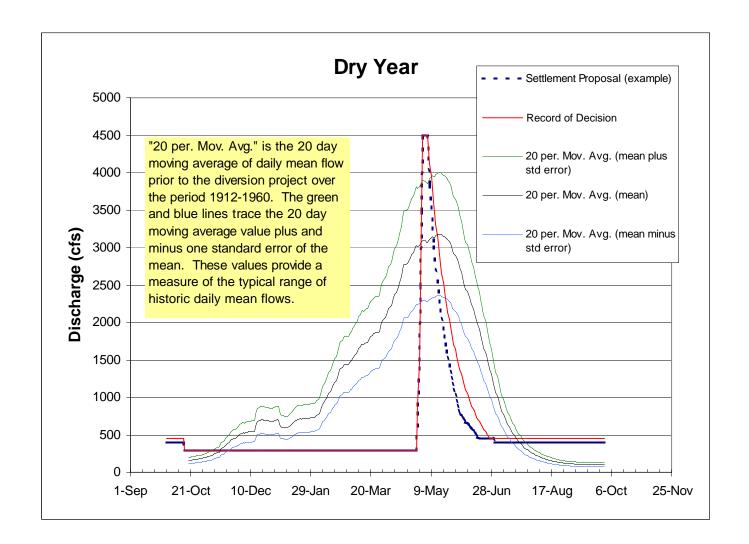
Charts

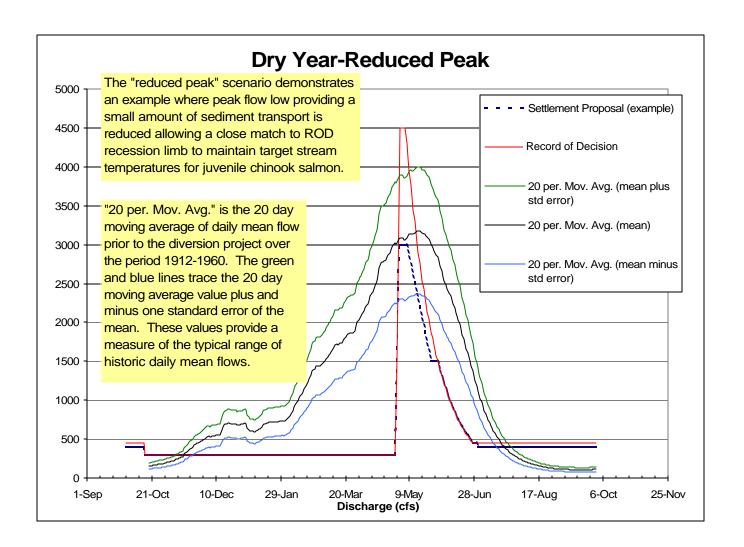
The accompanying charts compare examples of flows in the Westlands settlement proposal to flows called for in the Record of Decision as well as historic flows that occurred on the Trinity prior to the construction of Lewiston Dam for each of the climatic year categories.

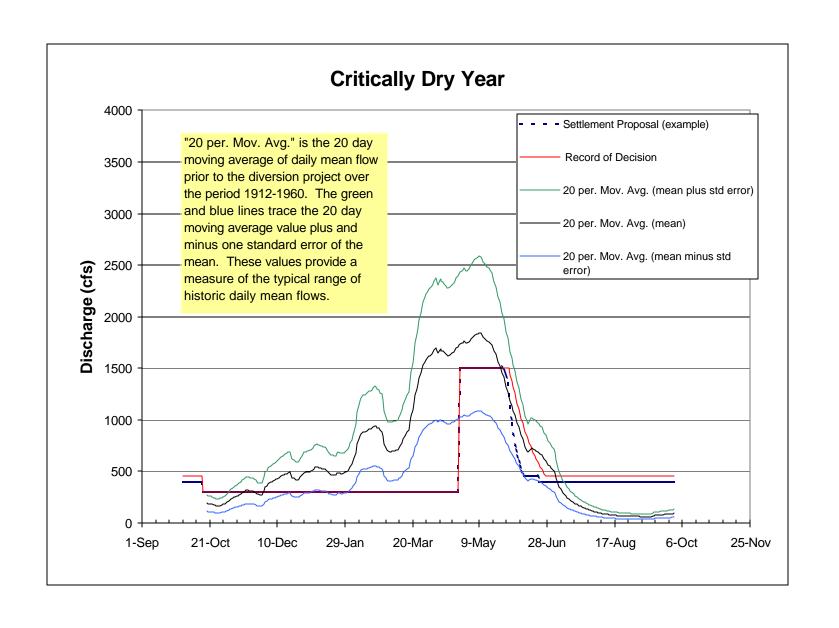
- Wet Year Hydrograph shows the flows that would likely occur under the Westlands proposal compared to flows likely to occur under the Record of Decision in a wet water year.
- Normal Year Hydrograph shows the flows that would likely occur under the Westlands proposal compared to flows likely to occur under the Record of Decision in a normal water year.
- Dry Year Hydrograph shows the flows that would likely occur under the Westlands proposal compared to flows likely to occur under the Record of Decision in a dry water year.
- Dry Year Reduced Peak Hydrograph shows an example of modified ROD flows where peak flow intended to provide a small amount of sediment transport is reduced, allowing settlement proposal flows to match the ROD recession limb intended to maintain favorable river temperatures for migrating juvenile Chinook salmon.
- Critically Dry Year Hydrograph shows the flows that would likely occur under the Westlands proposal compared to flows likely to occur under the Record of Decision in a critically dry water year.
- The Long-Term Comparison chart compares Trinity River flows between 1912 and 1960 prior to the construction of Lewiston Dam and flows that would likely have occurred under the Record of Decision and the Westlands Settlement Proposal.











-	water year	max flow	TAc-ft/yr	year class	TRFE- ROD	Settlement Proposal	Settlement Proposal Year Class	year	ranked	rank
	1912	9960	1029	normal	649.9	575	normal	1958	2694	1
	1913	7450	1074	normal	649.9	575	normal	1941	2547	2
	1914	24600	2028	ext wet	815.2	815.2	ext wet	1915	2154	3
	1915	18500	2154	ext wet	815.2	701	wet	1938	2105	4
	1916	22200	1506	wet	701	650	normal	1914	2028	5
	1917	8250	652	dry	452.6	340	crit dry	1956	2027	6
	1918	7250	602	crit dry	368.6	340	crit dry	1927	1826	7
	1919	18000	1151	normal	649.9	575	normal	1952	1817	8
	1920	2860	408	crit dry	368.6	340	crit dry	1942	1804	9
	1921	17300	1795	wet	701	701	wet	1921	1795	10
	1922	6750	783	dry	452.6	400	dry	1940	1613	11
	1923	4380	686	dry	452.6	340	crit dry	1953	1612	12
	1924	6940	266	crit dry	368.6	340	crit dry	1951	1610	13
	1925	15700	1499	wet	701	701	wet	1954	1595	14
	1926	16200	809	dry	452.6	400	dry	1916	1506	15
	1927	29600	1826	wet	701	701	wet	1925	1499	16
	1928	16000	1058	normal	649.9	575	normal	1946	1415	17
	1929	3620	529	crit dry	368.6	340	crit dry	1948	1205	18
	1930	20000	814	dry	452.6	400	dry	1919	1151	19
	1931	4120	402	crit dry	368.6	340	crit dry	1943	1108	20
	1932 1933	7870	721 804	dry	452.6	340 400	crit dry	1949 1957	1090	21
	1933	6840	683	dry	452.6		dry		1083	22 23
	1934	11300 7360	966	dry	452.6 452.6	340 400	crit dry	1913 1928	1074 1058	23 24
	1935	10800	1025	dry dry	452.6 452.6	400	dry dry	1945	1036	2 4 25
	1937	11700	999	dry	452.6	400	dry	1959	1048	26
	1938	32400	2105	ext wet	815.2	815.2	ext wet	1912	1029	27
	1939	3800	573	crit dry	368.6	340	crit dry	1960	1025	28
	1940	34500	1613	wet	701	701	wet	1936	1025	29
	1941	27000	2547	ext wet	815.2	815.2	ext wet	1937	999	30
	1942	19700	1804	wet	701	650	normal	1935	966	31
	1943	5940	1108	normal	649.9	575	normal	1950	854	32
	1944	4880	654	dry	452.6	340	crit dry	1930	814	33
	1945	6540	1048	normal	649.9	575	normal	1926	809	34
	1946	16300	1415	wet	701	701	wet	1933	804	35
	1947	6670	732	dry	452.6	340	crit dry	1922	783	36
	1948	30700	1205	normal	649.9	575	normal	1955	735	37
	1949	14500	1090	normal	649.9	575	normal	1947	732	38
	1950	5730	854	dry	452.6	400	dry	1932	721	39
	1951	22700	1610	wet	701	701	wet	1923	686	40
	1952	14400	1817	wet	701	701	wet	1934	683	41
	1953	14300	1612	wet	701	701	wet	1944	654	42
	1954	18900	1595	wet	701	701	wet	1917	652	43

year	ranked	rank	probability	cumu prob	year class	no. in class
1958	2694	1	0.12	0.12	ext wet	6
1941	2547	2	0.12		ext wet	
1915	2154	3	0.12		ext wet	
1938	2105	4	0.12		ext wet	
1914	2028	5	0.12		ext wet	
1956	2027	6	0.12		ext wet	
1927	1826	7	0.22	0.35	wet	11
1952	1817	8	0.22		wet	
1942	1804	9	0.22		wet	
1921	1795	10	0.22		wet	
1940	1613	11	0.22		wet	
1953	1612	12	0.22		wet	
1951	1610	13	0.22		wet	
1954	1595	14	0.22		wet	
1916	1506	15	0.22		wet	
1925	1499	16	0.22		wet	
1946	1415	17	0.22		wet	
1948	1205	18	0.24	0.59	normal	12
1919	1151	19	0.24		normal	
1943	1108	20	0.24		normal	
1949	1090	21	0.24		normal	
1957	1083	22	0.24		normal	
1913	1074	23	0.24		normal	
1928	1058	24	0.24		normal	
1945	1048	25	0.24		normal	
1959	1042	26	0.24		normal	
1912	1029	27	0.24		normal	
1960	1025	28	0.24		normal	
1936	1025	29	0.24		normal	
1937	999	30	0.29	0.88	dry	14
1935	966	31	0.29		dry	
1950	854	32	0.29		dry	
1930	814	33	0.29		dry	
1926	809	34	0.29		dry	
1933	804	35	0.29		dry	
1922	783	36	0.29		dry	
1955	735	37	0.29		dry	These
1947	732	38	0.29		dry	become
1932	721	39	0.29		dry	critically dr
1923	686	40	0.29		dry	years unde
1934	683	41	0.29		dry	settlement
1944	654	42	0.29		dry	proposal
1917	652	43	0.29		dry	proposar

1955	5570	735	dry	452.6	340	crit dry
1956	38700	2027	ext wet	815.2	815.2	ext wet
1957	18700	1083	normal	649.9	575	normal
1958	26100	2694	ext wet	815.2	701	wet
1959	19000	1042	normal	649.9	575	normal
1960	15800	1025	normal	649.9	575	normal
		TAF/yr		TAF/yr	TAF/yr	
mean		1189.0		586.8	535.0	
std dev		572		148	165	
std error		81.7		21.2	23.5	
		% of pre-p	roject	49.4%	45.0%	
		% of TRFE	-ROD		91.2%	

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